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Subject: Proposal for a Program to Evaluate Hot-Dipped Plastic Packaging

In general accordance with our previous correspondence on the subject of hot-dipped plastic packaging and recent conversations with your project engineers, both here at the Reservation and at your office, we submit this proposal for a program designed to produce, test and evaluate hot-dipped plastic packages for some twelve (12) units designated by you.

In general, the proposed program is divided into seven (7) distinct phases, as follows:

- 2 wk. Phase I: Brief literature study of the cook-off characteristics of the explosive and incendiary materials in the units under consideration.
- 6 wk. II: Cook-off testing of the unit types under consideration.
- 6 wk. III: Hot-dipped plastic packaging of the unit types under consideration.
- IV: Conditioning of the packaged units.
- V: Storage and burial of the packaged units.
- VI: Functional testing of the units from Phases III, IV and V.

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Phase VII: Evaluation of results and Final Report writing.

The ultimate objectives of the proposed program are to develop safe, efficient and practical methods for the hot-dipped plastic packaging of the items under consideration, and to evaluate the effectiveness of this type packaging against various conditions of natural and simulated storage.

In detail, the proposed program includes the following items:

PHASE I: Literature Study

A limited literature study will be made of the published data related to the cook-off characteristics of the incendiary and explosive materials in the units to be packaged. Since the Ordnance Research group here at the Reservation has long been interested and had experience in testing of explosives and incendiary cook-off, maximum use shall be made of all available information and assistance from this source during this phase.

The ultimate objective of this phase is to abstract applicable information, tabulate its sources for any future work in this field by your office, and, finally, provide this information in suitable form for the guidance of work to be conducted under Phases II and III of this proposal.

While the duration of the literature study is difficult to predict, it is anticipated that a maximum of two (2) weeks will be required.

PHASE II: Cook-off Testing

Concurrently with the Phase I literature study, preparations for the cook-off testing program will be made, including:

- a) Design and construction of an oil tank and its associated oil heating and pumping equipment for sample heating.
- b) Construction of a small blast pit for the tank, located adjacent to existing Ordnance cook-off testing facilities.
- c) Installation of the tank, temporary power, control and recorder wiring to the existing facilities and instrumentation.
- d) Calibration and practice runs, using dummy items, to insure proper functioning of equipment and development of operating technique.

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Actual cook-off testing will be initiated as soon after completion of Phase I work and the preparatory Phase II work as possible, consistent with the requirements of our Safety Department. The units to be tested are as follows:

- a) R. R. Signal Device
- b) Plastic explosives C-3 and C-4
- c) Primacord and Black Powder Time Fuze
- d) Pull-Type Fuze Lighters
- e) Pocket Incendiary units
- f) Thermit Well units
- g) Rocket Incendiary Adapters, 2.36" and 3.50"
- h) Mark I and/or Mark II Pencil Units
- i) AC Delay Packages
- j) Fuzee Match Heads

The cook-off test program will be conducted along the following lines:

- 1) Beginning with the least powerful explosive and incendiary materials or units, cook-off conditioning of both bare and packaged units will be accomplished at 385-400 F on at least three (3) samples of each unit.
- 2) Some units, by the nature of their construction and/or materials, cannot be dipped in the unpackaged (bare) condition because of leakage into the unit, low melting-point of materials, extreme material sensitivity, etc. The R. R. Signal, Thermit Well, C-3 and C-4 explosives are cases in point. When such conditions exist, no attempt shall be made to accomplish cook-off testing in the bare condition, since no useful information or experience could be gained.
- 3) Failure of an unpackaged (bare) unit by cook-off in test will require that a second series of samples be tested in the packaged condition;

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this would determine whether or not the addition of the thermal barrier and air film provided by a package would appreciably increase the cook-off time to make possible the safe hot plastic packaging of the unit.

- 4) All units tested would be fitted with thermocouples to record various temperatures within the unit and its package during dipping. Maximum temperatures and temperature gradients will be established for each item in this way.
- 5) In the testing of the C-3, C-4 and primacord samples, the total weight of explosive subjected to each test shall be reduced to the point where it does not represent a problem of either personnel or equipment safety in the event of actual cook-off.

Again, it is difficult to estimate the time required to complete this part of the testing phase, since so much depends on the actual test results. It is believed that the maximum time required for the completion of cook-off testing under adverse conditions (as represented by frequent cook-offs and the necessary re-testing) would be six (6) weeks. In combination with the two (2) week preparatory time required, the total time for completion of Phase II is estimated to be eight (8) weeks.

The ultimate objective of this phase is to supply sufficient information to allow a prediction to be made as to whether or not each of the units under consideration can actually be hot-dipped without danger from cook-off during the dipping process.

PHASE III: Hot-Dipping of Items

For each item found to be suited to safe dipping, either bare or in envelopes, the packaging work can be commenced as soon as the cook-off testing is completed for that particular unit type. In no case, however, shall full-size samples of C-3, C-4, primacord, or the rocket incendiary adapters be packaged until the dipping tank and its associated equipment can be moved and re-installed in an open demolition area with additional remote-operating hoists to allow full safety for the operators in the event of a major explosion.

Assuming that the cook-off tests indicate that all units are capable of being hot dipped, the following numbers of each unit will be so packaged in approximately the following order:

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- a) R. R. Signal Device: Twenty (20) unit packages in envelopes and twenty (20) individual units wrapped in aluminum foil.
- b) Black Powder Time Fuze: Twenty (20) pieces in unit package envelopes.
- c) Fuze Lighters: Twenty (20) in unit package envelopes.
- d) Pocket Incendiary: Twenty (20) cans in unit pack envelopes and twenty (20) bare cans, both red pencils.
- e) Thermit Well: Twenty (20) in unit package envelopes.
- f) Time Pencils: Twenty (20) bare unit package cans, forty (40) bare pencils and four (4) unit package boxes, all red or black pencils.
- g) AC Delay: Twenty (20) kits in unit package envelopes and twenty (20) in bare unit package cans, including M31 detonators in each.
- h) Fuzee Match Head: Twenty (20) boxes in unit package envelopes.
- * i) C-3 and C-4: Twenty (20) 2-1/4 pound blocks of each, in individual unit package envelopes.
- * j) Primacord: Twenty (20) pieces in unit package envelopes and twenty (20) pieces bare.
- * k) Rocket Incendiary Adapters: Twenty (20) each of 2.36" and 3.50" units in unit package envelopes, and twenty (20) in bare cans.

* Indicates dipping operation to be accomplished in open Demolition Area installation.

The actual dipping operations will be conducted to develop techniques for the handling of each package type to yield:

- a) Complete closure of plastic about the item or envelope.
- b) Minimum bulk consistent with (a).

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- c) Uniformity of exterior shape of package to allow efficient final packaging or boxing.
- d) Development of alternative methods of handling.
- e) Quick, safe and efficient processing consistent with (a), (b), and (c).

In all probability many individual dipping operations will be required for the accomplishment of the above. The ultimate purpose of this phase, however, remains to develop and produce satisfactory hot-dipped plastic packaging for each of the items under consideration in sufficient quantities to support the conditioning and testing phases outlined in the following sections.

It is estimated that six (6) weeks will be required to complete Phase III.

PHASE IV: Conditioning of Packaged Items

In accordance with our recent conversations on the conditioning of the unit packaged items, the work under this phase would include:

- a) 48-hour conditioning: One-quarter of the units in each package type will be allowed to condition for 24 hours at room temperature before being forwarded to functional testing. Testing of this group will be accomplished within 48 hours after dipping. (See Phase VI)
- b) Cycling Conditioning: One-quarter of the units in each package type will be subjected to the following temperature-humidity cycling before being forwarded to functional testing:
 - 1) 4 hours at 160°F and 90% RH
 - 2) 2 hours at 90°F and 90% RH
 - 3) 2 hours at -35°F
 - 4) 16 hours at 50°F and 25% RH
 - 5) Total of 4 cycles as outlined above.

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Units in this group will be functional tested within 48 hours after completion of the cycling conditioning. (See Phase VI)

It is estimated that it will require a total of two (2) weeks after the completion of Phase III to complete the cycling conditioning of all items under consideration.

PHASE V: Storage of Packaged Items

Two (2) conditions of storage will be accomplished for the packaged units as follows:

- a) Igloo Storage: One-quarter of the units in each package type shall be boxed in Class 2 pine boxes with corrugated liners, built to hold the sample snugly, and shall be stored in the igloos for six (6) months. Weekly temperature and humidity recordings shall be made to define as closely as possible the igloo storage conditions.
- b) Burial: One-quarter of the units in each package type shall be buried, without exterior packaging, in moist or wet loam-type soil for a period of six (6) months. The explosive items cannot be buried within the security compound at the Reservations for reasons of safety; these items shall be kept under a close security watch during the burial period. The remaining items will be buried within the bounds of the Reservation compound.

PHASE VI: Functional Testing

Functional testing of the items under consideration shall be conducted in five (5) groups, as follows:

- a) Original sample tests, to define the original operational characteristics of the units within the lot selected for hot plastic dip packaging. In many cases, the nature of the units are well enough known here at the Reservation, by virtue of previous testing, so that no original sample testing will be required. Those units requiring original sample testing are:

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- 1) R. R. Signal Units, because of the high failure possibilities of black powder used in the unit. A total of fifteen (15) units shall be tested.
 - 2) Thermit Well Units, because of moisture susceptibility of the first fire mixture. A total of ten (10) units will be tested.
 - 3) Rocket Incendiary Adapter Units, because of unfamiliarity with normal functional characteristics of these units. A total of five (5) units will be so tested.
- b) 48-hour tests of all units, to determine whether or not there are any early effects on the unit performance as the result of the high temperatures or mineral oil leakage during hot-dipped plastic packaging.
 - c) Post-Cycling Tests, of all units, to determine whether or not the protection afforded the units by hot-dipped plastic packaging is adequate to prevent deterioration during and after the temperature and humidity extremes of the cycle test.
 - d) Post-Igloo Storage Tests, for all items, to determine whether or not the protection afforded by the hot-dipped plastic packaging is adequate to prevent deterioration during the igloo storage period.
 - e) Post Burial Tests, for all items, to determine whether or not the protection afforded by the hot-dipped plastic packaging is adequate to prevent deterioration during burial storage.

In general, the first two (2) groups, (a) and (b) above will be done simultaneously. The remaining tests, because of the time factors involved, must be done separately.

The ultimate purpose of this phase is to provide information, for use in evaluation and reporting in Phase VII, regarding both the effects on the units of hot-dipped plastic packaging and the protection offered the units against various adverse conditions of storage.

It is estimated that testing for the various groups will be completed within 48 hours after completion of their respective conditioning.

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PHASE VII: Evaluation and Report Writing

The final report for this program will accomplish the following:

- a) Define the steps of each Phase, so that the methods of approach to the problem are recorded both verbally and by photographs.
- b) Evaluate the results obtained in each Phase.
- c) Make firm recommendations for procedures and techniques based on the above evaluation, for the hot-dipped plastic packaging of the units under consideration.
- d) Extrapolate, insofar as believed valid, these recommendations into the field of general packaging of similar items by the hot plastic dipping method.

Project Duration

Since a considerable amount of the cook-off, dipping, functional testing and evaluation work can be accomplished simultaneously, it is believed that the total time required to complete the work outlined and publish the Final Report will be nine (9) months from the time of our receipt of a Work Order. This relatively long duration is caused primarily by the six (6) month storage and burial requirement.

Reports

In addition to close verbal liaison with your project personnel, it is anticipated that the program will require reports on the following basis:

- a) Status Reports similar to those currently required for other cases, submitted at the end of each six (6) week period.
- b) Informal letter reports upon the completion of significant phases of the work or in the event of a notable change in the original program planning.
- c) The Final Report, as outlined in Phase VII.

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Personnel

[] will be in charge of the program for [] 25X1
 and it is understood that he will look to [] for guidance and assistance from your office. Formal Reports and project supervision will be under the guidance of [], and matters of funds and policy will be under the direction of [] 25X1 25X1

Consideration

In view of the fact that the proposed project would be active during the early months and relatively inactive in the later months of storage and conditioning, it is felt that our usual presentation of costs, based on a uniform monthly expenditure of funds, would not provide a clear picture of the fiscal requirements of this project. In place of this, therefore, we have substituted the following two (2) breakdowns, the first being by category and the second, by Phase.

Summary of Costs by Category

Labor

Technical

Engineering, Supervision and Design

Administrative

Total

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Equipment

Materials

Travel and Subsistence

Telephone and Telegraph

ADL Fee, @ 7%

Total

\$13,583.00

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* [] pending confirmation from auditors
 of overhead rates for calendar year 1954.

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Summary of Costs by Phase (all items considered)

Phase I	\$680.00
Phase II	4,475.00
Phase III	4,215.00
Phase IV	488.00
Phase V	1,010.00
Phase VI	<u>2,715.00</u>

Total

\$13,583

Very truly yours,

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Approved by

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cc:
cc:

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